REMARKS

Claims 1-25 now stand in the present application, claim 1 having been amended and new claims 10-25 having been added. Applicant notes with appreciation the Examiner's indication of allowable subject matter in claims 2-5, but respectfully submits that in view of the above amendments and the following remarks that all of the claims are now in condition for allowance.

In the Office Action, the Examiner has rejected claims 1, 6, 8 and 9 under 35 U.S.C. §102(e) as being anticipated by Murade. In view of the above described claim amendments to claim 1, the Examiner's §102 rejection of these claims is believed to have been overcome, as will be described in greater detail below.

Applicant's invention is directed to an improved active matrix liquid crystal display device in which the switching element is covered either above or below by a convex shading layer. The shape of the shading layer is important in that it prevents reflected light from reaching the switching element. Applicant has amended claim 1 to more clearly recite that at least one of the upper and lower shading layers includes a sloped portion and a convex shape which is disposed opposite to and protruding toward a gate electrode of the switching element.

Murade at Figure 6 has been pointed out by the Examiner to include an upper shading layer 7 (misnumbered in the reference as 14) as anticipating Applicant's claim 1. However, the upper shading layer of Murade does not have a sloped portion and a convex shape disposed opposite to and protruding toward a gate electrode of the switching element. Instead, as shown in Figure 6, the upper shading layer of Murade is

disposed between scan lines 2 which act as common gate electrodes in the liquid crystal display device of Murade. Thus, Murades' teaching of an upper shading layer is not disposed and arranged in the manner disclosed and claimed in the present application and would therefore not provide any of the benefits enumerated in the present application. Accordingly, claim 1 as amended, and its respective dependent claims 6-9 are believed to patentably define over Murade.

The Examiner has also rejected claims 1 and 7-9 under 35 U.S.C. §103(a) as being unpatentable over Rho et al. Applicant respectfully traverses the Examiner's §103 rejection of these claims.

As noted by the Examiner, Rho et al. does not teach or suggest a lower shading layer. More importantly, however, the shading layer 110 of Rho et al. has a completely flat region which is disposed opposite to the gate electrode of the switching elements in its liquid crystal display. For example, as shown in Figure 4, a completely flat shading layer 110 overlies gate electrode 20. Although, it is true that at the ends of the shading layer 110 there are beads, it is also clear that these beads do not meet amended claim 1 which now recites that at least one of the upper and lower shading layers includes a sloped portion having a convex shape disposed opposite to and protruding toward a gate electrode of the switching element. Therefore, claim 1 as amended and its respective dependent claims 7-9 are also believed to patentably define over Rho et al.

Newly added claims 10-25 represent original claims 6-9 but dependent upon respectively allowed claims 2-5. Accordingly, all of claims 10-25 are also believed to be in condition for allowance.

Therefore, in view of the above amendments and remarks, it is respectfully requested that the application be reconsidered and that all of claims 1-25, standing in the application, be allowed, and that the case be passed to issue. If there are any other issues remaining which the Examiner believes could be resolved through either a Supplemental Response or an Examiner's Amendment, the Examiner is respectfully requested to contact the undersigned at the local telephone exchange indicated below.

Respectfully submitted,

NIXON & VANDERHYE P.C.

By: ______________________
Chris Comuntzis
Reg. No. 31,097

CC:lmr
1100 North Glebe Road, 8th Floor
Arlington, VA 22201-4714
Telephone: (703) 816-4075
Facsimile: (703) 816-4100

VERSION WITH MARKINGS TO
<u>SHOW CHANGES MADE IN THE SPECIFICATION</u>

<u>IN THE SPECIFICATION</u>:

Please replace the paragraph beginning at page 1, line 13 with the following new paragraph:

--Liquid crystal display devices are known for [its] <u>their</u> advanced characteristics such as <u>being</u> light-weight, <u>having</u> reduced thickness, and <u>exhibiting</u> low power consumption, and active research and development is performed in the field. A liquid crystal display comprises "pixel elements" arranged in matrix, which are formed by placing liquid crystal molecules in between transparent electrodes. When an arbitrary voltage is provided between the transparent electrodes corresponding to each pixel element, the alignment of the liquid crystal molecules in the pixel element is changed, and the degree of polarization of the light passing through the liquid crystal is varied, which leads to controlling the transmission rate of the light. The liquid crystal display device is divided into two types based on operation principles, that is, the simple matrix type and the active matrix type. Since the active matrix liquid crystal display device utilizes active elements<u>,</u> [of the] TFT<u>s,</u> switching elements for individual pixel elements, independent signals [could] <u>can</u> be transmitted to each pixel element, and [it is capable of providing] <u>the device provides</u> improved resolution and <u>a</u> clear display image.--

Please replace the paragraph beginning at page 2, line 6 with the following new paragraph:

--A TFT utilizing amorphous silicon thin film is often used as the switching element for the active matrix liquid crystal display device. Moreover, a recently proposed technique refers to a TFT that utilizes a polysilicon thin film formed either by heat treating an amorphous silicon thin film in a temperature over 600 °C, or by providing a laser crystallization in which a pulse laser (such as an excimer laser) is radiated to the thin film for recrystallization. The polysilicon thin film is [advantages] advantageous in that it has higher mobility compared to the amorphous silicon thin film, which allows for not only the switching elements for the pixels but also the driving circuit for driving the switching elements of the pixels to be formed on the same substrate using the polysilicon TFT.--

Please replace the paragraph beginning at page 2, line 19 with the following new paragraph:

--As mentioned above, the liquid crystal display device controls the transmission rate of the light passing through the liquid crystal by changing the degree of polarization of the light passing through the liquid crystal, but the device itself is not equipped with a light emitting member. Therefore, a light source of some sort must be provided to the device. For example, in the case of a transmission-type liquid crystal display device, a lighting device, [so-called a] a so-called light, is placed on the back side of the liquid crystal display, and the light transmitted through the device enables images to be displayed. In the case of a projector, a metal halide lamp and the like are used as the light source, and image is projected by combining the liquid crystal display device with a

lens system. Moreover, in case of a reflection-type display, the incident light provided from the exterior is reflected by a reflecting electrode in order to display an image.--

Please replace the paragraph beginning at page 3, line 9 with the following new paragraph:

--In general, if light is radiated to a semiconductor, such as silicon, and light absorption occurs, electrons are excited to the conductive band and positive holes are excited to the [valece] valence band, generating electron-hole pairs and causing a so-called photoelectric effect. The same could be said for the amorphous silicon thin film or the polysilicon thin film utilized as the pixel switching elements. By radiating light thereto, electron-hole pairs are generated in the thin film. Accordingly, when light is radiated to the TFT using either the amorphous silicon thin film or the polysilicon thin film as the active layer, photocurrent is caused by the electron-hole pairs, which increases the leak current during the off-state of the TFT. This leads to deteriorating the contrast and the like of the liquid crystal display.--

Please replace the paragraph beginning at page 3, line 23 with the following new paragraph:

--In the case of a reflection-type liquid crystal display device, the reflecting electrode mainly composed of a metal film connected to the TFT is arranged to cover the TFT, so that no incident light from the exterior reaches the TFT directly. [Thereby]Accordingly, TFT leak current [of the TFT] is prevented from increasing. However, in the case of a transmission-type liquid crystal display device, the TFT is not

only exposed constantly to the strong light from the back light, but some incident light other than that from the back light also tends to reach the TFT. Moreover, in the case of projectors, the light reflected by the lens may reach the TFT. Accordingly, various inventions are proposed that aim at preventing incident light from reaching the TFT.--

Please replace the paragraph beginning at page 4, line 10 with the following new paragraph:

--For example, as shown in FIG. 11, [a proposal is made in providing a] shading film 63 and [a] shading film 64 are provided above and under the switching electrode 62 via insulation layers, in order to block the light coming from above and under the switching element (Japanese Patent Application Laid-Open Publication No. 58-159516). This is effective in reducing leak current, and in improving [the] display characteristics.--

Please replace the paragraph beginning at page 4, line 17 with the following new paragraph:

--According to another proposal, as shown in FIG. 12, in an adhered SOI substrate, an upper shading layer 66 and a lower shading layer 67 [is] are provided above and under a MOSFET 65, in order to block the direct incident light coming from above and under the MOSFET, and to also block the light reflected by the back surface of the substrate, thereby effectively preventing an increase of TFT leak current [of the TFT] (Japanese Patent Application Laid-Open Publication No. 10-293320).--

Please replace the paragraph beginning at page 5, line 8 with the following new paragraph:

--According to the above method, shading layers are provided above and under the TFT so as to prevent incident light coming in from the exterior from reaching the semiconductor film or active layer of the TFT, and most of the incident light fails to reach the semiconductor film. However, the incident angle of the light coming into the liquid crystal display device is not always perpendicular the substrate, but has a certain degree of dispersion, and the light entering the display device may be repeatedly reflected within the device. When light reaches the TFT according to these reasons, the light causes problems such as an increase of TFT leak current [of the TFT].--

Please replace the paragraph beginning at page 5, line 19 with the following new paragraph:

--As shown in FIG. 10 (a), light (A) and light (B) are blocked by the upper shading layer 54 and the lower shading layer 51, and they will not reach the TFT 55. However, the oblique incident light (C) coming from the side of upper shading layer 54 [side] is reflected by the lower shading layer 51, and reaches the TFT 55. Moreover, the oblique incident light (D) coming from the side of upper shading layer 54 side is reflected by the lower shading layer 51, then reflected by the upper shading layer 54, before reaching the TFT 55. Similarly, the incident light (E) and (F) coming from the side of lower shading layer 51 [side] also [reached] reaches the TFT 55 after being reflected [once] one or more times. Therefore, according to the proposal of Japanese Patent

Application Laid-Open Publication No. 58-159516, [the] light traveling as mentioned above will reach the transistor[,] causing an increase of leak current.--

Please replace the paragraph beginning at page 6, line 8 with the following new paragraph:

--Moreover, as shown in FIG. 10 (b), when the upper shading layer 60 is larger than the lower shading layer 57, the oblique incident light (C), (D) and (G) coming from the side of upper shading layer 60 [side] is blocked by the upper shading layer, but on the other hand the oblique incident light (E), (F) and (I) coming from the side of lower shading layer 57 [side] still reaches the TFT 61, and the oblique incident light (H) coming from the side of lower shading layer [side] that would not have reached the TFT if the upper and lower shading layers were the same size also reaches the TFT 61 since it is reflected by the back surface of the upper shading layer 60. As mentioned above, according to the invention disclosed in Japanese Patent Application Laid-Open Publication No. 10-293320, [the] light traveling as [mentioned] described above will reach the transistor[,] causing an increase of leak current.--

Please replace the paragraph beginning at page 6, line 22 with the following new paragraph:

--Moreover, according to the method indicated in Japanese Patent Application Laid-Open Publication No. 10-319435, the light (G) coming in from the side of upper shading layer [4 side] 54 shown in FIG. 10 (a), or the light (I) coming in from the side of lower shading layer 57 [side] shown in FIG. 10 (b) will be diffused by the fine uneveness

of the surface of the shading layer, and some of the light that would have reached the TFT if not for the diffusion will be removed effectively. However, since the direction of light reflected by the uneven surface of the shading layer is random, the light that would have reached the TFT by the second reflection if the surface of the shading layer were smooth would reach the TFT by a single reflection. The [invention] described arrangement causes some light[s] to reach the TFT more easily, thereby causing an increase of leak current, similarly [as] to the other two prior art examples.--

Please replace the paragraph beginning at page 7, line 10 with the following new paragraph:

--As explained above, it [was] is difficult according to [the] prior art techniques to prevent [the] incident light traveling obliquely into the display device from above and under the device from reaching the TFT. By sufficiently increasing the size of the upper and lower shading films, it may be possible to reduce the intensity of the light reaching the TFT reflecting many times on the upper and lower shading films, by the reflection rate of the upper and lower shading films and the light absorption caused by the insulation film between the upper and lower shading films. However, according to such a method, the area of the shading films are insufficiently increased, causing other problems such as reduction of aperture rate, an important element of liquid crystal displays. Moreover, the increase of size of the shading films does not fundamentally prevent light from reaching the TFT.--

Please replace the paragraph beginning at page 20, line 3 with the following new paragraph:

--Next, as shown in FIG. 5 (h), wet etching is performed through HF and the like, using resist 16 as the mask. Since wet etching is an isotropic etching, the etching spreads wider than the opening portion 17 of the resist 16, and forms a shape as shown in FIG. 5 (h). Accordingly, the position of the resist mask and the size of the opening of the resist 16 are to be formed based on the idea disclosed in the "[summery] summary (means to solve the problem)". Moreover, the process accuracy of the photolithography and the etching and the alignment accuracy of the resist to the lower shading layer and the TFT active layer should be considered when forming the resist 16. Dry etching using gas such as CF_4 or CF_4+CHF_3 could be performed instead of the wet etching.--

Please replace the paragraph beginning at page 25, line 1 with the following new paragraph:

--Thereafter, an insulation film 28 not shown is formed, followed by a contact hole 29 formed on the insulating film. A transparent electrode such as ITO is electrically connected to the drain electrode 31. The above method realizes a liquid crystal display device that is capable of preventing [icident] incident light coming from upper and lower directions from reaching the TFT.--

VERSION WITH MARKINGS TO SHOW CHANGES MADE IN THE CLAIMS

IN THE CLAIMS:

Please amend claim 1 as follows.

1. (Amended) An active matrix liquid crystal display device comprising a liquid crystal cell, a switching element arranged in matrix, and shading layers mounted both on the upper side and the lower side of said switching element; wherein

at least one of the upper and lower shading layers includes a sloped portion and has a convex shape disposed opposite to and protruding toward a gate electrode of said switching element.

VERSION WITH MARKINGS TO SHOW CHANGES MADE IN THE ABSTRACT

ABSTRACT

The object of the invention is to provide an active matrix liquid crystal display device having improved brightness and higher contrast, and the method for manufacturing the same. An active matrix liquid crystal display device has on the upper side and the lower side of the switching element, arranged in matrix, a lower shading layer [2] and [a] an upper shading layer [18, wherein either]. Either the lower shading layer [2] or the upper shading layer [18] is, or both the lower and upper shading layers [2 and 18] are, formed to have a convex shape [protruding toward the switching element] and [including] a sloped portion [181] protruding toward the switching element.

[(FIG. 1)]

CLEAN VERSION OF THE ABSTRACT

ABSTRACT

The object of the invention is to provide an active matrix liquid crystal display device having improved brightness and higher contrast, and the method for manufacturing the same. An active matrix liquid crystal display device has on the upper side and the lower side of the switching element, arranged in matrix, a lower shading layer and an upper shading layer. Either the lower shading layer or the upper shading layer is, or both the lower and upper shading layers are, formed to have a convex shape and a sloped portion protruding toward the switching element.